<u>IN THE DRAWINGS</u>

Applicants propose to revise the reference number in Fig. 2 of the drawings in accordance with the accompanying ANNOTATED SHEET SHOWING CHANGES.

Enclosed herewith is a REPLACEMENT SHEET in which the above change has been incorporated.

<u>REMARKS</u>

Enclosed herewith is a Substitute Specification in which the specification as filed has been amended in various places to correct typographical and grammatical errors, and to also add section headings. The specification as filed has also been amended to cite U.S. Patent 6,367,049 corresponding to the cited WO 00/07300. Enclosed herewith is form PTO/SB/08A listing this U.S. patent.

In support of the above, enclosed herewith is a copy of the specification as filed marked up with the above changes.

The undersigned attorney asserts that no new matter has been incorporated into the Substitute Specification.

The drawings have been amended such that in Fig. 2, the 3rd layer ECC parity extractor now bears the reference number 14.

The claims have been amended to more clearly define the invention as disclosed in the written description. In particular, claim 9 has been cancelled. In addition, claims 1-8, 10 and 12 have been amended for clarity.

The subject invention relates to embedding an additional layer of error correction into an error correcting code, in which the error correcting code has been formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block. As such, the embedding method of the subject invention takes the error correcting code and encodes the rows of the user data

sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities. The embedding method then embeds the horizontal parities as an additional layer into the original error correcting code.

Applicants believe that the above changes and explanation answer the Examiner's objection to and 35 U.S.C. 112, paragraph 2, rejection of the claims, and respectfully request withdrawal thereof.

The Examiner has rejected claims 1, 2, 9 and 12 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,712,861 to Inoue et al. in view of U.S. Patent 7,024,616 to Ohira et al. The Examiner has further rejected claim 3 under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. in view of Ohira et al., and further in view of U.S. Patent 6,061,820 to Nakakita et al. In addition, the Examiner has rejected claim 4 under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. in view of Ohira et al., and further in view of U.S. Patent 5,276,674 to Tanaka. Moreover, the Examiner has rejected claim 5 under 35 U.S.C. 103(a) as being unpatetnable over Inoue et al. in view of Ohira et al. and Tanaka, and further in view of U.S. patent 5,696,774 also to Inoue et al. (herein "Inoue et al.(2)). The Examiner has furthermore rejected claims 6-8 under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. in view of Ohira et al. and Tanaka, and further in view of the article "Subspace subcodes of Reed-Solomon codes" by Hattori et al. The Examiner has also rejected claim 10 under 35 U.S.C. 103(a)

as being unpatentable over Inoue et al. in view of Ohira et al and

Tanaka, and further in view of International Patent Application No.

WO 99/34271 to Tolhuizen et al.

The Inoue et al. patent discloses an error correcting

method and decoder with improved reliability.

The Examiner states:

"Inoue teaches encoding the rows of at least said user
data sub-block separately or in groups using a
horizontal error correcting code (Cl code in Figure 1
in Inoue is a horizontal error correcting code encoding
the rows of a 76x1 38 user data sub-block) over a
second Galois field (the C, code in Inoue is over the
Galois field for the C, Reed-Solomon code) different in
size than said first Galois field (the C2 code is over
the Galois field for the C2 Reed-Solomon code) to
obtain horizontal parities, embedding said horizontal
parities as additional layer in said error correcting
code (See Figure 1 in Inoue)."

Applicants submit that the Examiner is mistaken. In

particular, Inoue et al. specifically states "FIG. 1. illustrates

the format of a product code with novel parity check symbols, used

in a first embodiment: of the invention." (col. 11, lines 27-29).

Inoue et al. then further describes Fig. 1 at col. 12, line 62 to

col. 13, line 58. There is no disclosure or suggestion that an

error correcting code, formed by encoding information into code

words of the error correcting code over a first Galois field, and a

number of code words are arranged in the columns of a code block

comprising a user data sub-block and a parity data sub-block, is

further encoded by encoding the rows of the user data sub-block

using a horizontal error correcting code over a second Galois field

larger than the first Galois field, to form at least horizontal

parities, and that the horizontal parities are then embedded into the original error correcting code. This is specifically claimed in, for example, claim 1, and is shown in Fig. 2 wherein the forming of the error correcting code is performed by the LDC encoder 11, while the blocks 12, 13, 14 and 15 further encode the error correcting code to form at least horizontal parities, which are embedded into the original error correcting code by the interleaver 16.

Applicants submit that none of this is shown or suggested by Inoue et al.

The Ohira et al. patent discloses a method for encoding/decoding error correcting code, transmitting apparatus and network, in which "Fig. 9A shows examples of possible C1 codes which can be applied to a combination of Kc, Nc, and Fig. 9B shows examples of possible C2 codes which can be applied to a combination of Kr, Nr, ξ" (Col. 19, lines 6-9).

It is unknown to Applicants how this relates to the second Galois field being larger than the first Galois field, since Inoue et al. only discloses one Galois field GF(2^8).

Notwithstanding the above, Applicants submit that Ohira et al. does not supply that which is missing from Inoue et al., i.e., an error correcting code, formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is

further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

The Nakakita et al. patent discloses a scheme for error control on ATM adaption layer in ATM networks, which states, at col. 37, lines 1-10:

> "In Figs. 11A and 11B, there is a padding portion in the last column, and it is possible to realize a scheme in which no data for the FEC encoding is added to this portion. However, it is desirable to add at least a symbol for LI to the data for the FEC encoding, so that the actual implementation is expected to be easier by adding something (even if it is all "0" data) to the padding portion as well. If the FEC encoding which does not include any padding portion is to be carried out, there can be a row with no data at all (that is, the message M is null)."

It is unclear to Applicants how this relates to the adding of "zero" bits to a codeword prior to undergoing an encoding process. However, notwithstanding the above, Applicants submit that Nakakita et al. does not supply that which is missing from Inoue et al. and Ohira et al., i.e., an error correcting code, formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to

form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

The Tanaka patent discloses an optical recording medium having thin protective layer and two-dimensionally aligned code words and recording/reproducing apparatus employing the same, and indicates "The 104 symbols in a column direction are added with parities of 16 symbols and form the RS code (120, 104). Such a long RS code is named as a Long Distance Code (LDC)." (col. 1, lines 55-58).

However, Applicants submit that Tanaka does not supply that which is missing from Inoue et al. and Ohira et al., i.e., an error correcting code, formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

The Inoue et al.(2) patent discloses a digital signal recording device, digital playback device, and digital signal decoding device therefor, which makes mention of $GF(2^9)$. However, Applicants submit that Inoue et al.(2) does not supply that which is missing from Inoue et al., Ohira et al. and Tanaka, i.e., an error correcting code, formed by encoding information into code

words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

The Hattori et al. article discloses "Subspace Subcodes of Reed-Solomon Codes". However, Applicants submit that Hattori et al. does not supply that which is missing from Inoue et al., Ohira et al. and Tanaka, i.e., an error correcting code, formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

The Tolhuizen et al. reference (indicated as Baggen by the Examiner) discloses a method for encoding multiword information by wordwise interleaving and error protection, with error locative clues derived from high protectivity words and directed to low protectivity words, a method for decoding such information, a device for encoding and/or decoding such information, and a carrier

provided with such information, in which Burst Indicator Subcode in used. However, Applicants submit that Tolhuizen et al. does not supply that which is missing from Inoue et al., Ohira et al. and Tanaka, i.e., an error correcting code, formed by encoding information into code words of the error correcting code over a first Galois field, and a number of code words are arranged in the columns of a code block comprising a user data sub-block and a parity data sub-block, is further encoded by encoding the rows of the user data sub-block using a horizontal error correcting code over a second Galois field larger than the first Galois field, to form at least horizontal parities, and that the horizontal parities are then embedded into the original error correcting code.

In view of the above, Applicants believe that the subject invention, as claimed, is not rendered obvious by the prior art either individually or collectively, and as such, is patentable thereover.

Applicants believe that this application, containing claims 1-8 and 10-16 (claims 11 and 13-16 having been withdrawn), is now in condition for allowance, and such action is respectfully requested.

Respectfully submitted,

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